Space Weather Technical Forecast

Issued on Monday, 05 September 2022 at 13:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Chance of M-class flares (R1-R2 Blackouts). G1/G2 Minor/Moderate Geomagnetic Storm likely day 1 (5th). Fluence increasing.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity was Low with numerous C-class flares throughout, the largest being a C8.3 observed at 04/1638 UTC, originating from AR3089. There are currently six sunspots on the visible disc. The largest and most complex is AR3089, approaching the southwestern limb, which means it is now very difficult to assess the magnetic structure due to foreshortening. All other remaining spots remain relatively small and simple, with only minor growth. There have been no Earth directed CMEs seen in satellite imagery over the last 24 hours, although there is still the possibility of a glancing blow today from a CME launched on 2nd September.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, was indicative of a HSS, most likely from CH20/+. The wind speed declined from near 700 km/s to around 550 km/s. Density was average or just above average. Total interplanetary magnetic field strength, Bt, was weak to moderate, peaking around 10 nT. The north-south component, Bz, was largely negative, varying between +7/-8 nT. The Phi angle was largely positive (away from the Sun). Geomagnetic activity was mostly G1/Minor to G2/Moderate storm.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured at GEOS-16 was at background levels. The high energy electron flux (greater than 2 MeV) was mostly at Moderate to High levels, with a peak of 6690 pfu at 04/1625 UTC. The 24-hour integrated electron fluence has been below the Active threshold (1e8 integrated pfu) on a rising trend, with 6.93e7 integrated pfu observed at 05/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to remain largely Low, with an ongoing chance of Moderate flares, mostly from AR3089. This spot will likely exert influence on the flare risk due to its location until the end of day 3 (7th). New region(s) may rotate onto the east limb on day 1 (5th), potentially increasing the probabilities of significant flares.

Solar Wind / Geomagnetic Activity: The CME that left the Sun on 2nd Sept may give Earth a glance on day 1 (5th). No other Earth-directed CMEs expected. Solar winds will initially be elevated due to the HSS from CH20/+ on day 1 (5th), gradually easing to slightly elevated during day 2 (6th), perhaps continuing into day 4 (8th). Further periods of G1/Minor to G2/Moderate Geomagnetic Storms are likely on day 1, with a very slight chance of further G3/Strong (Kp7) Storms. The baseline Geomagnetic activity should begin to reduce to Active to Unsettled with a chance of G1/Minor into day 2, before reducing to mostly Quiet to Unsettled by day 4.

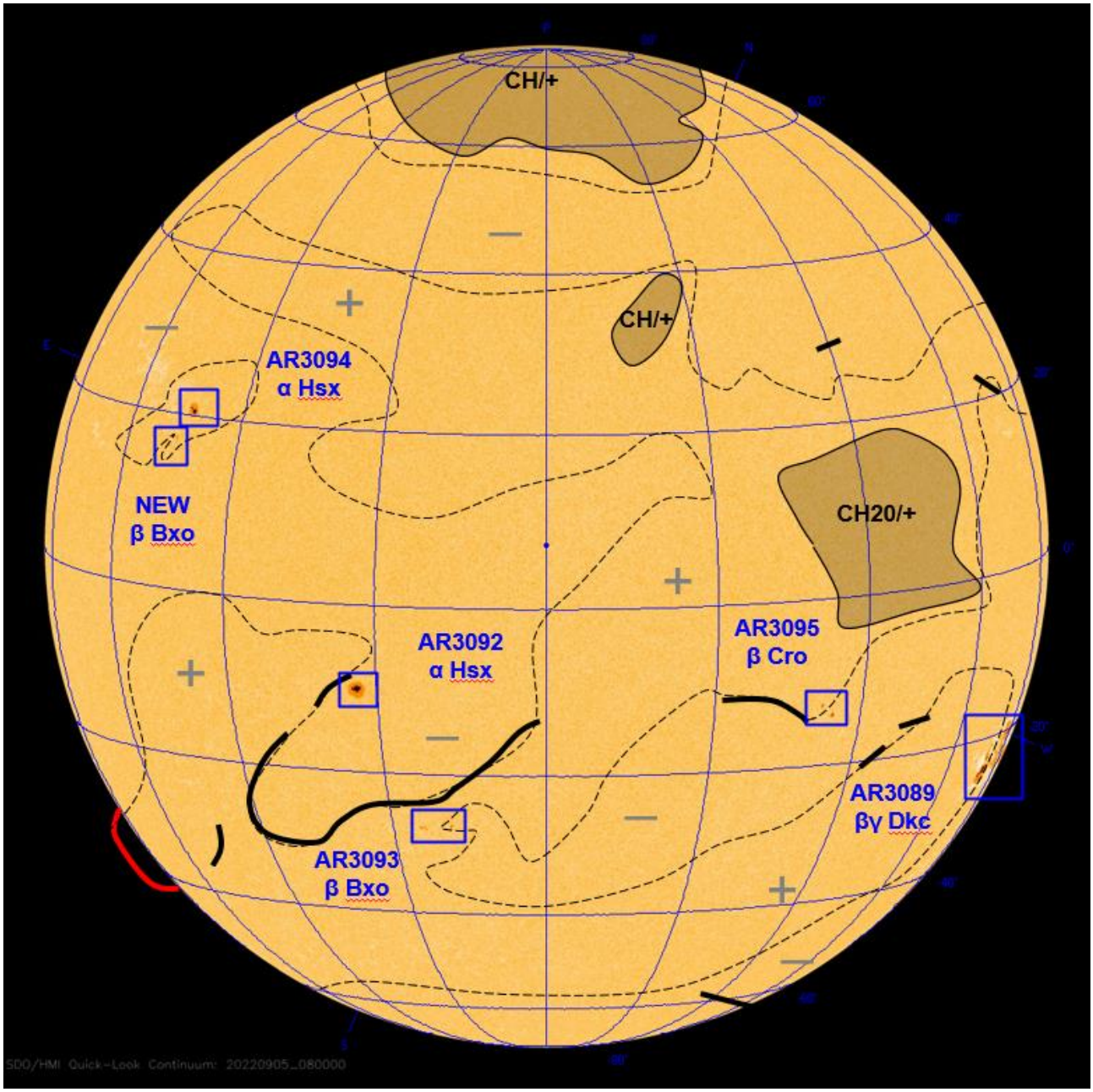
Energetic Particles / Solar Radiation: High energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels, with a slight chance of an increase should we see any larger flares from AR3089. The high energy (greater than 2 MeV) electron flux is expected to rise erratically and become high over the following days. The corresponding

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

24 hour fluence is expected to display a sharp rising trend from day 1, with a chance of exceeding the Active threshold on day 1 (5th) then expected from day 2 (6th) onward.

Figure 1. Solar Analysis Valid 05/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

A marked filament eruption was observed leaving the Sun on 2nd September. The CME that followed may give a glancing blow at Earth on day 1 (5th), with a possible arrival time around midday UTC. ENLIL suggests only a slight perturbation in the already elevated wind speeds on 5th Sept, with impacts likely to be minimal due to the glancing nature of any arrival.

Solar winds are currently elevated due to the HSS originating from CH20/+. Solar winds are expected to remain elevated through the first half of the period before slightly declining as we exit the influence of CH20/+ during day 2 (6th). There remains uncertainty around a smaller positive coronal hole shortly following CH20/+ in the northern hemisphere. On the last rotation there was a large coronal hole following CH20/+ but there is now only a small feature here which may give an extended period of slightly elevated wind speeds into Day 3 or 4 (7th and 8th). Further periods of G1/Minor to G2/Moderate Geomagnetic Storms are likely on day 1, with a very slight chance of further G3/Strong (Kp7) Storms. The baseline Geomagnetic activity should begin to reduce to Active to Unsettled with a chance of G1/Minor into day 2, before reducing to mostly Quiet to Unsettled by day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	60	30	10	1
Strong	G3	No	5	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

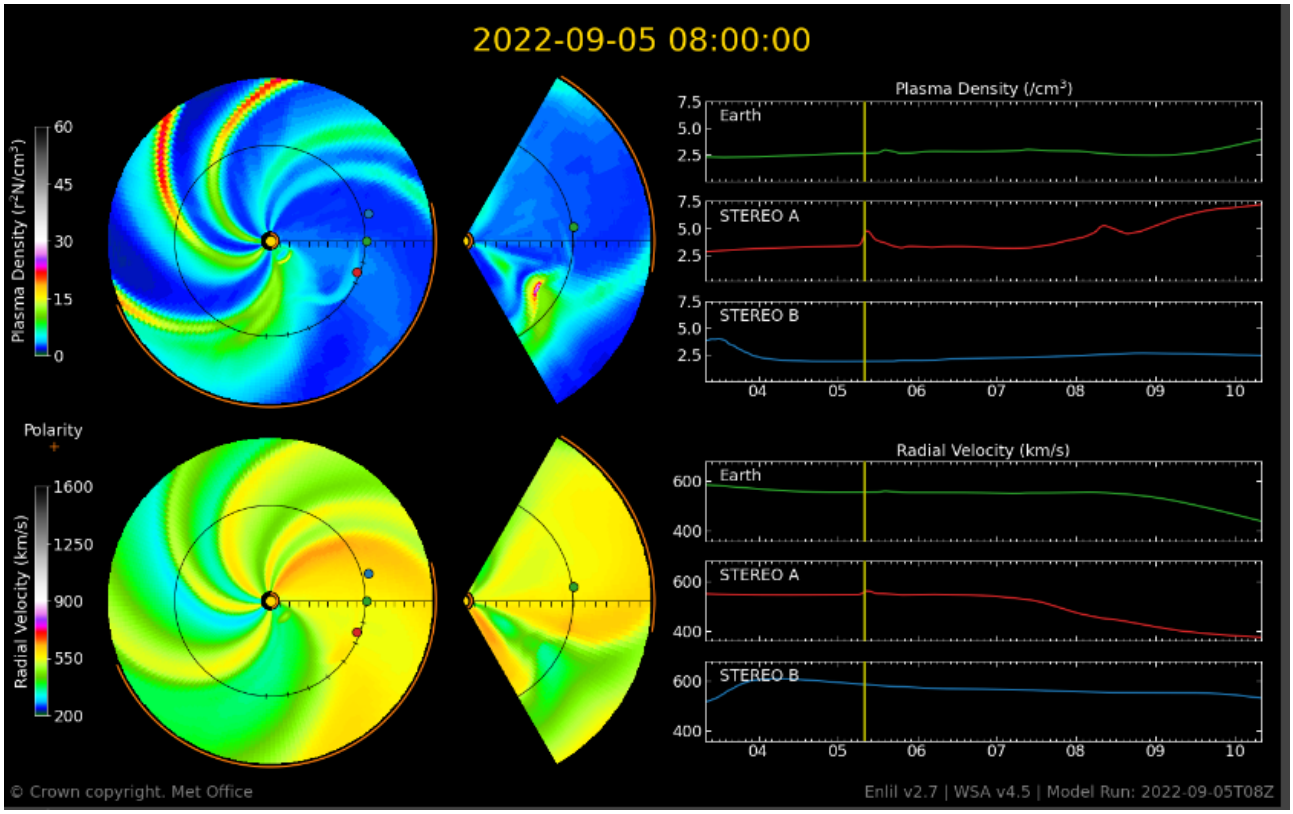
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
03/0751	Nil	Filament eruption	SE	750 km/s	05/1200 UTC	Glancing blow probable

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 2: MOSWOC Enlil model showing a possible CME glancing blow Day 1 (5th). Wind speeds may decline a little earlier than shown by Enlil.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

There are now six sunspot regions on the visible disc. The largest and most complex remains AR3089, which is approaching the southwest limb, meaning it is now much more difficult to analyse due to foreshortening. It is now impossible to assess whether it still contains a delta spot, however it appears to be relatively stable, only producing C-class flares. However, there is still the chance of further M-class flares as it continues to rotate off the southwest limb in the coming days. All other remaining sunspots regions are all small and simple.

A large filament is visible in the southeast quadrant and will need to be monitored for any lift-off, particularly when it approaches the central meridian.

Solar activity is expected to remain largely Low, with an ongoing chance of Moderate flares at times, mostly from AR3089. However far-side imagery indicates the presence of potential active regions approaching the east limb. The new regions rotating on may balance the loss of AR3089 in terms of probabilities, but the new regions cannot be assessed until they become visible.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	45	45	45
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) remains at background values. Despite its apparent stability, AR3089 (Dkc/Beta-Gamma) continues to present a slight chance of a proton event at Earth, should there be any significant flaring. This risk will continue until the region is well over the west limb.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

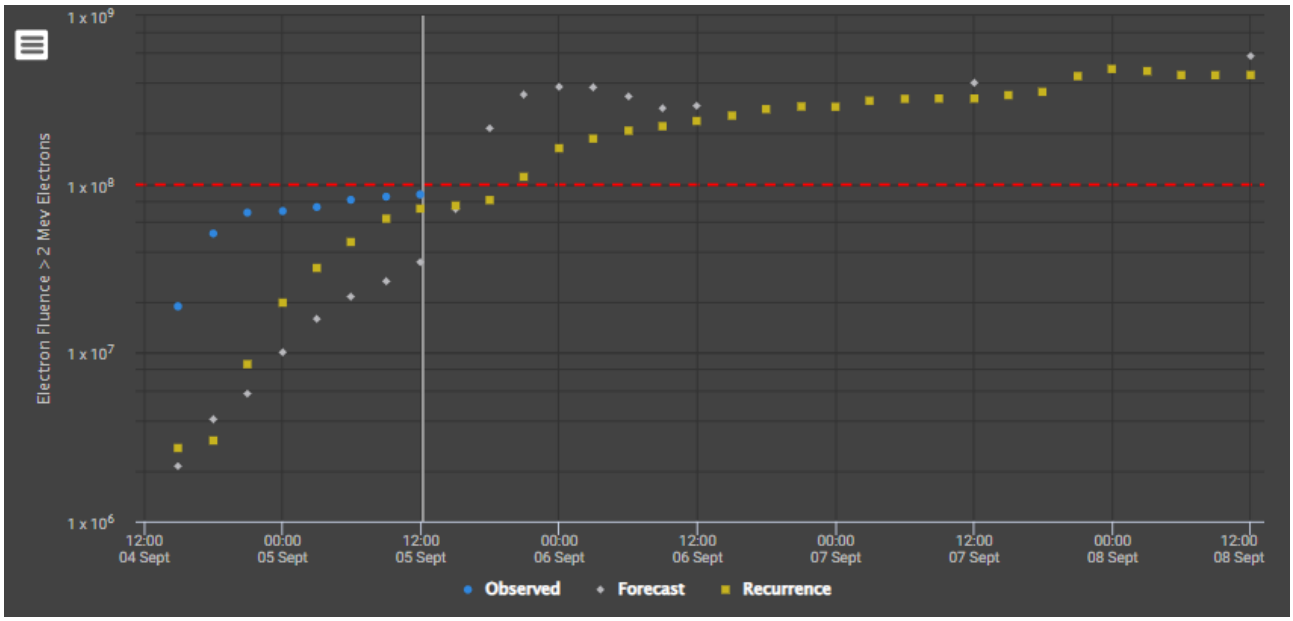
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux has been moderate to high, due to the recent enhancement from the fast speed streams originating from CH19/+ and CH20/+, recharging the Van Allen belts in electron populations. Flux levels are expected to continue to rise erratically during day 1 (5th), likely remaining above high levels during days 2 to 4 (6th-8th).
The corresponding 24-hour fluence is expected to continue displaying a rising trend, with a chance of exceeding the Active threshold from day 1 (5th) then expected from day 2 (6th) onward. This is supported the latest Met Office REFM output, although the model is currently slightly under-estimating fluence levels.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	40	70	70	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	5	5

Figure 3: MOSWOC REFM showing a rising trend for electron fluence, likely above Active.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.